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EM1230

SINGLE-PHASE ELECTRONIC ENERGY METER

OVERVIEW

The **EM1230** low-cost reference design for a single-phase energy meter is based on the ADSST-EM-1000, Analog Devices' Digital Signal Processor (DSP). Extensive hardware optimization combines with an innovative low-cost method of analog-to-digital conversion to digitize the voltage and current signals. The resulting design remotely reads all measured parameters and remotely calibrates the meter.

Figure 1 depicts the functional block diagram of the EM1230. To sense the instantaneous current, a linear Hall-effect device has been used. Instantaneous voltage is scaled down using a resistive potential divider. The output from the Hall- effect sensor, after level shifting, and the voltage from the potential divider are fed to the Pulse Width Modulators (PWM chips). The PWM chips output pulses with variation in the duty cycle proportional to the input signals.

HIGHLIGHTS

- ADSST-EM-1000 DSP-based design
- Conforms to IEC-1036 standards for Class 1 Static Energy meters
- 230V/110V Single-Phase operation
- Maximum input current 20A RMS (can be extended up to 60A)
- Measures Active Energy, Active and Apparent Power, Power Factor and Supply Frequency
- Optically-isolated Asynchronous Port connects to an RS-232 port
- Remote Calibration of Meter
- 6-digit LED display

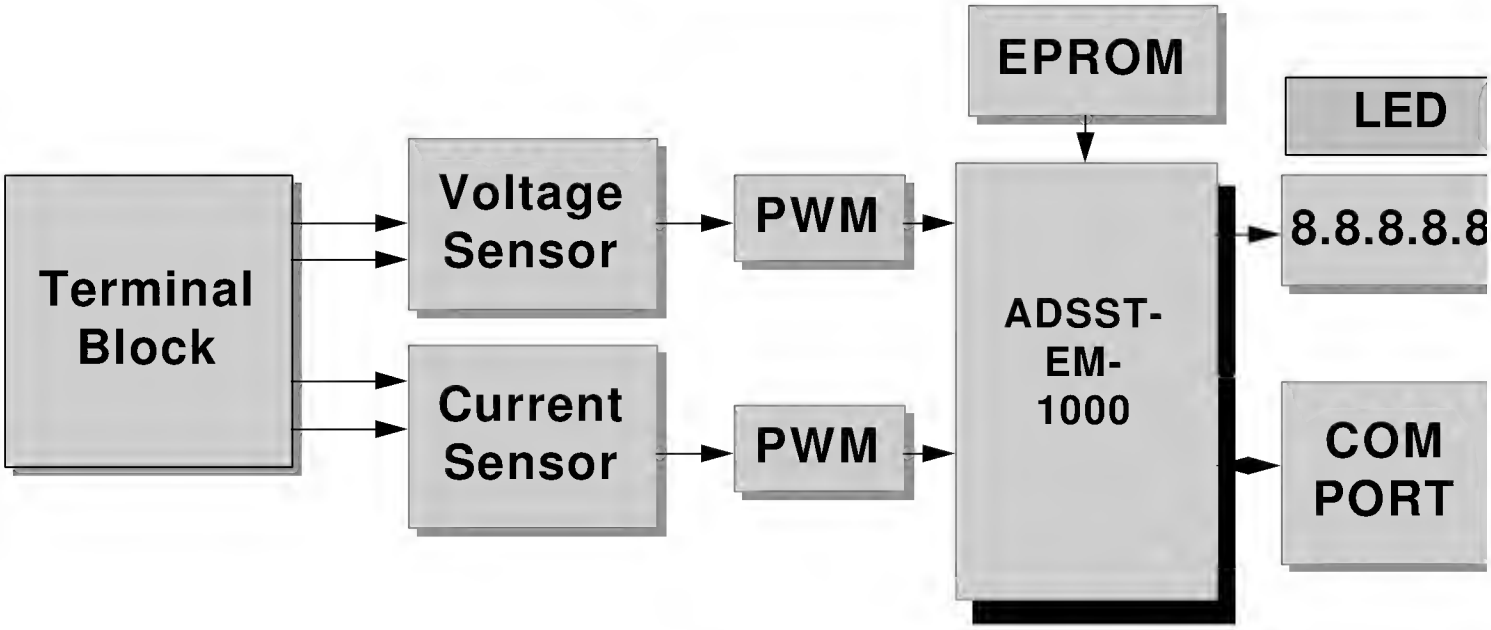

Figure 1

Figure 2 portrays the block diagram of this acquisition of voltage and current signals. The internal programmable timer of the DSP is used to decode the instantaneous duty cycle of the voltage and current PWM wave forms with the help of a hardware Edge Separation Logic (ESL). The ESL generates an output pulse corresponding to the rising and falling edge of the PWM signal. The output pulses of the ESL circuit interrupt the DSP, where the time difference between the two interrupts i.e., difference between the two timer count values, gives the instantaneous value of the voltage and current samples.

The resolution of this analog-to-digital conversion process depends on the pulse repetition rate (sampling rate) of the PWM. With a sampling rate of 3.7 KHz and a DSP clock frequency of 15.36 MHz, approximately 11 bits of conversion resolution is obtained. A common timing circuit for both the PWM circuits ensures the synchronization of voltage and current channels. Variations in output from such conversion, caused by temperature changes, are compensated in software in the ADSST-EM-1000. From the digitized values of voltage and current, power is calculated over synchronous intervals and the energy is computed by the ADSST-EM-1000 by integrating these power measurements.

The EM1230 has an optically-isolated asynchronous communications port and operates in a simplex mode. The asynchronous communication is a software implementation on the ADSST-EM-1000 chipset without using an external UART. The ADSST-EM-1000 chipset also is used for multiplexing the digital display, to display the computed parameters. The efficient usage of ADSST-EM-1000 chipset and software implementation of some of the hardware functions proved effective in the cost reduction.

Software & Memory Requirements

The EM1230 software resides on a single byte-wide EPROM (8 K x 8). On power-on, the software gets loaded automatically into the internal program memory (1 K x 24 bit SRAM) of the ADSST-EM-1000 and starts executing. The measured values of voltage and current and the calculated value of power are stored in the internal data memory (512 x 16 RAM). The computed energy values are updated at regular intervals and written on a serial EEPROM (256 x 16).

Calibration and Parameter Monitor Program

The EM1230 single-phase energy meter can be calibrated using a remote terminal or an IBM PC or compatible. The optically-isolated asynchronous communication port on the EM1230 provides connectivity to the RS232 port on the PC or remote terminal. A user-friendly, menu-driven, PC-compatible software application is included, enabling the user to configure and perform calibration with ease. DC-offset and gain for voltage and current channels, and active power noise and current channel noise can be calibrated and stored in the EEPROM. This calibration procedure does not require any adjustment of trim potentiometers or hardware modifications. A red-color LED on the left-hand side of the seven- segment display is useful to check the incremental rate of Active Energy. The nominal pulse rate of blinking on this LED is 1000 pulses/KWh.

The Parameter Monitor Program enables the manufacturer or user to select the parameters that are to be displayed. A red-color LED on the left-hand side of the display is useful to check meter tampering. This LED, which is normally off, switches on when the meter detects phase-reversal of current flowing into the load terminals. The Initialization option on the menu-driven software can be used to reset the LED.

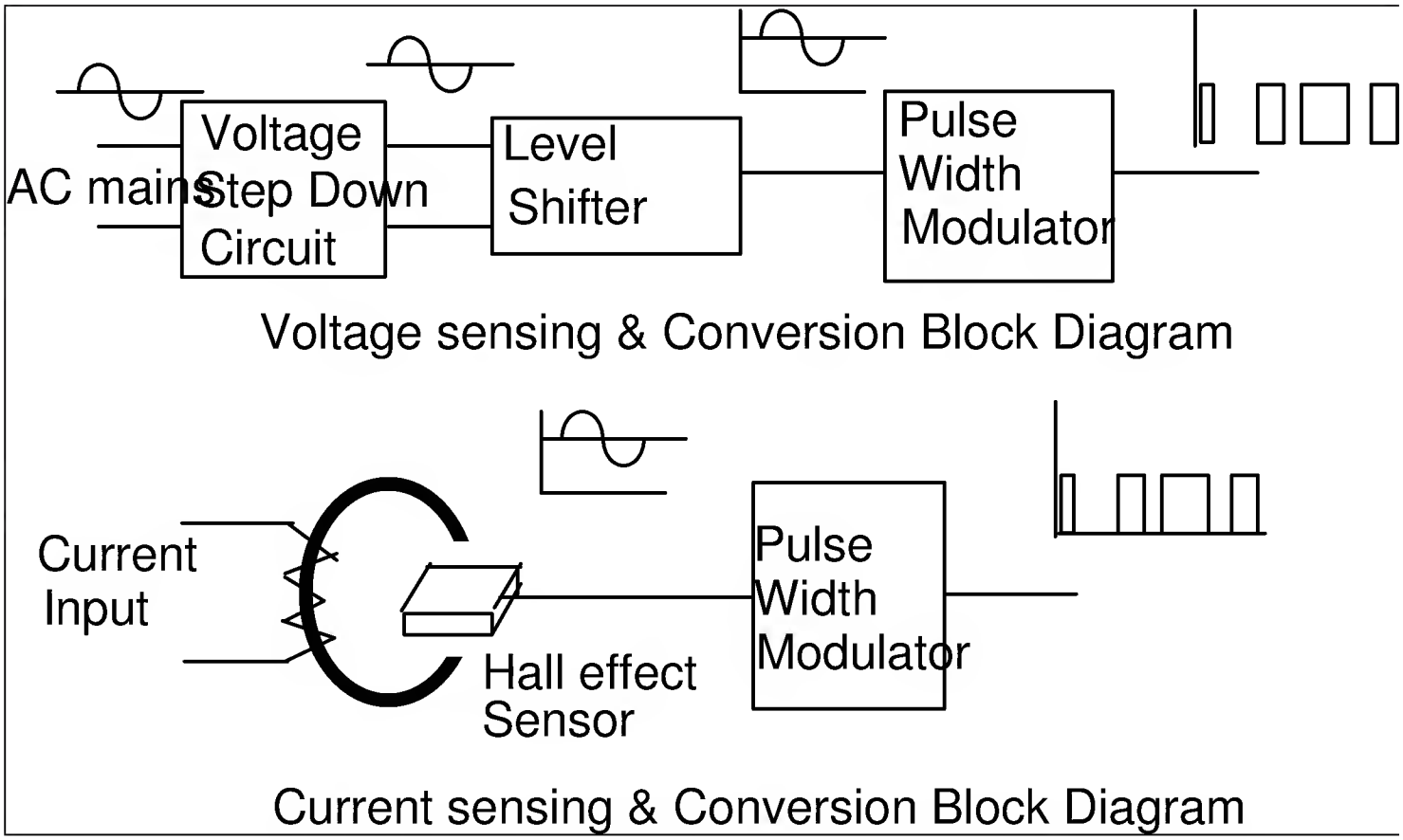

Figure 2

System Specifications

Operating Voltage Range	: 230V/110V15%,50/60Hz
Max. Current Input	: 20A RMS
Accuracy (Active energy)	: +/- 1% of measured value
Sampling Rate	: 3.750 KHz
Display	: 6-digit 7-segment LED display
Display Resolution	: 0.1 Wh/0.1kWh (software configurable)
Max. Power Consumption	: 2W
Operating temperature range	: 0^{o} to 50^{o} C
Asynchronous Port	: Optically isolated, 2400 baud, 8-data bits, 1 Stop bit, no-parity

Analog Devices, Inc., together with *Signion Systems Pvt. LTD.* are developing the most advanced software system solutions today.

All designs using this software must use ADSST-EM-1xxx for ordering. The chipset consists of a DSP processor and software. A license agreement must be signed.

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